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RECORDING METHOD FOR PHASE CHANGE TYPE OPTICAL DISK

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Applicant:	RICOH KK
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- european:	
Application number:	JP19950087295 19950413
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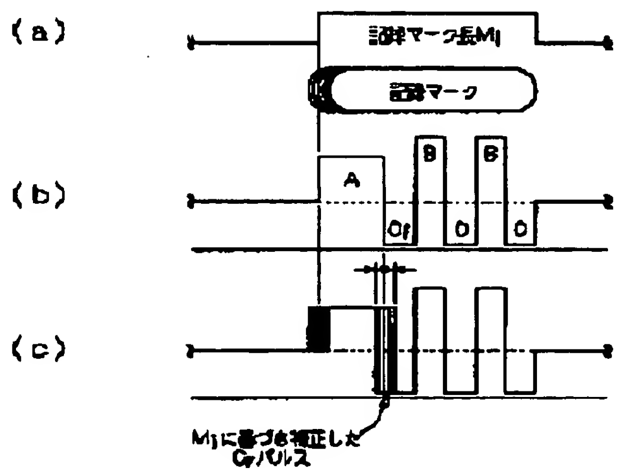
Abstract of **JP8287465**

PURPOSE: To suppress jitters of a recording mark interval by properly correcting an edge shift of a recording mark caused by various main causes in a phase change type optical disk phase changing in reversible a recording material in a crystal phase and an amorphous phase and recording information.
CONSTITUTION: A head cooling time is corrected by changing front edge timing of a head cooling pulse CF in immediately after of its head heating pulse A based on the recording mark length M1 of the recording mark becoming a write object. Thus, a rapid cooling condition is satisfied, and the correction is performed properly so that the rear edge shift of the recording mark is reduced, and the jitters of the recording mark interval are reduced.



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L1: Entry 2 of 2 File: DWPI Nov 1, 1996

DERWENT-ACC-NO: 1997-026382
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TITLE: Recording method for phase varying type optical disc such as CD, CD-ROM - by changing time interval of head cooling pulse based on recording mark length and head cooling time is corrected

PATENT-ASSIGNEE: RICOH KK (RICO)

PRIORITY-DATA: 1995JP-0087295 (April 13, 1995)

Search Selected Search ALL Clear

PATENT-FAMILY:

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JP 08287465 A	November 1, 1996		017	G11B007/00
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ABSTRACTED-PUB-NO: JP 08287465A
BASIC-ABSTRACT:

The method makes use of a recording layer that changes to crystalline phase or amorphous phase. A multi pulsed laser light consisting of a continuous cooling pulse (C) positioned between a head heating pulse (A) and a continuous heating pulse (B), is intensity modulated and is transmitted.

A mark (M1) containing a recording information is illuminated based on which the time interval of a head cooling pulse (CF) positioned behind the head heating pulse is changed and so that head cooling time is corrected.

ADVANTAGE - Corrects increase or decrease of front shift of recording mark. Reduces jitter in recording mark space.

ABSTRACTED-PUB-NO: JP 08287465A
EQUIVALENT-ABSTRACTS:

PATENT ABSTRACTS OF JAPAN

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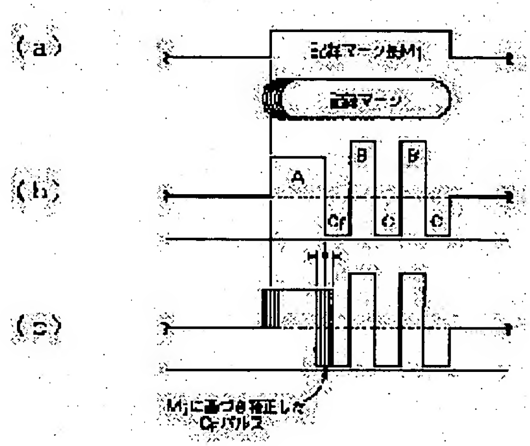
AOKI IKUO

(54) RECORDING METHOD FOR PHASE CHANGE TYPE OPTICAL DISK

(57)Abstract:

PURPOSE: To suppress jitters of a recording mark interval by properly correcting an edge shift of a recording mark caused by various main causes in a phase change type optical disk phase changing in reversible a recording material in a crystal phase and an amorphous phase and recording information.

CONSTITUTION: A head cooling time is corrected by changing front edge timing of a head cooling pulse CF in immediately after of its head heating pulse A based on the recording mark length M1 of the recording mark becoming a write object. Thus, a rapid cooling condition is satisfied, and the correction is performed properly so that the rear edge shift of the recording mark is reduced, and the jitters of the recording mark interval are reduced.



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CLAIMS

[Claim(s)]
[Claim 1] As opposed to the phase-change optical disk which has the recording layer which carries out a phase change reversibly with a crystal phase and an amorphous phase The multi-pulse laser light which consists of a head heating pulse, a consecutive continuation heating pulse, and a continuous cooling pulse located among these pulses and by which intensity modulation was carried out is irradiated. In the record approach for phase change type light DIKUSUKU which recorded information by forming the record mark whose die length bears information The record approach for phase-change optical disks characterized by changing the front edge timing of the head cooling pulse just behind the head heating pulse based on the record mark length who becomes a write-in object, and amending a head cooldown delay.
[Claim 2] As opposed to the phase-change optical disk which has the recording layer which carries out a phase change reversibly with a crystal phase and an amorphous phase The multi-pulse laser light which consists of a head heating pulse, a consecutive continuation heating pulse, and a continuous cooling pulse located among these pulses and by which intensity modulation was carried out is irradiated. In the record approach for phase change type light DIKUSUKU which recorded information by forming the record mark whose die length bears information The record approach for phase-change optical disks characterized by changing the back edge timing of the aftercooling pulse just behind the last heating pulse based on the record mark length who becomes a write-in object, and amending aftercooling time amount.
[Claim 3] As opposed to the phase-change optical disk which has the recording layer which carries out a phase change reversibly with a crystal phase and an amorphous phase The multi-pulse laser light which consists of a head heating pulse, a consecutive continuation heating pulse, and a continuous cooling pulse located among these pulses and by which intensity modulation was carried out is irradiated. In the record approach for phase change type light DIKUSUKU which recorded information by forming the record mark whose die length bears information While changing the front edge timing of the head cooling pulse just behind the head heating pulse based on the record mark length who becomes a write-in object The record approach for phase-change optical disks characterized by changing the back edge timing of the aftercooling pulse just behind the last heating pulse, and amending a head cooldown delay and aftercooling time amount.
[Claim 4] As opposed to the phase-change optical disk which has the recording layer which carries out a phase change reversibly with a crystal phase and an amorphous phase The multi-pulse laser light which consists of a head heating pulse, a consecutive continuation heating pulse, and a continuous cooling pulse located among these pulses and by which intensity modulation was carried out is irradiated. In the record approach for phase change type light DIKUSUKU which recorded information by forming the record mark whose die length bears information The record approach for phase-change optical disks characterized by changing the front edge timing of the head cooling pulse just behind a head heating pulse based on the tooth-space length in front of the record mark used as a write-in object, and amending a head cooldown delay.

[Claim 5] As opposed to the phase-change optical disk which has the recording layer which carries out a phase change reversibly with a crystal phase and an amorphous phase The multi-pulse laser light which consists of a head heating pulse, a consecutive continuation heating pulse, and a continuous cooling pulse located among these pulses and by which intensity modulation was carried out is irradiated. In the record approach for phase change type light DIKUSUKU which recorded information by forming the record mark whose die length bears information The record approach for phase-change optical disks characterized by changing the back edge timing of the aftercooling pulse just behind the last heating pulse based on the tooth-space length immediately after the record mark used as a write-in object, and amending aftercooling time amount.
[Claim 6] As opposed to the phase-change optical disk which has the recording layer which carries out a phase change reversibly with a crystal phase and an amorphous phase The multi-pulse laser light which consists of a head heating pulse, a consecutive continuation heating pulse, and a continuous cooling pulse located among these pulses and by which intensity modulation was carried out is irradiated. In the record approach for phase change type light DIKUSUKU which recorded information by forming the record mark whose die length bears information While changing the front edge timing of the head cooling pulse just behind a head heating pulse based on the tooth-space length in front of the record mark used as a write-in object The record approach for phase-change optical disks characterized by changing the back edge timing of the aftercooling pulse just behind the last heating pulse based on the tooth-space length immediately after the record mark used as a write-in object, and amending a head cooldown delay and aftercooling time amount.
[Claim 7] As opposed to the phase-change optical disk which has the recording layer which carries out a phase change reversibly with a crystal phase and an amorphous phase The multi-pulse laser light which consists of a head heating pulse, a consecutive continuation heating pulse, and a continuous cooling pulse located among these pulses and by which intensity modulation was carried out is irradiated. In the record approach for phase change type light DIKUSUKU which recorded information by forming the record mark whose die length bears information The record approach for phase-change optical disks characterized by changing the front edge timing of the head cooling pulse just behind a head heating pulse based on the record mark length who becomes a write-in object, and the tooth-space length in front of this record mark, and amending a head cooldown delay.
[Claim 8] As opposed to the phase-change optical disk which has the recording layer which carries out a phase change reversibly with a crystal phase and an amorphous phase The multi-pulse laser light which consists of a head heating pulse, a consecutive continuation heating pulse, and a continuous cooling pulse located among these pulses and by which intensity modulation was carried out is irradiated. In the record approach for phase change type light DIKUSUKU which recorded information by forming the record mark whose die length bears information The record approach for phase-change optical disks characterized by changing the back edge timing of the aftercooling pulse just behind the last heating pulse based on the record mark length who becomes a write-in object, and the tooth-space length immediately after this record mark, and amending aftercooling time amount.
[Claim 9] As opposed to the phase-change optical disk which has the recording layer which carries out a phase change reversibly with a crystal phase and an amorphous phase The multi-pulse laser light which consists of a head heating pulse, a consecutive continuation heating pulse, and a continuous cooling pulse located among these pulses and by which intensity modulation was carried out is irradiated. In the record approach for phase change type light DIKUSUKU which recorded information by forming the record mark whose die length bears information While changing the front edge timing of the head cooling pulse just behind a head heating pulse based on the record mark length who becomes a write-in object, and the tooth-space length in front of this record mark The record approach for phase-change optical disks characterized by changing the back edge timing of the aftercooling pulse just behind the last heating pulse based on the record mark length who becomes a write-in object, and the tooth-space length immediately after this record mark, and amending a head cooldown delay and aftercooling time amount.
[Claim 10] As opposed to the phase-change optical disk which has the recording layer which carries out

a phase change reversibly with a crystal phase and an amorphous phase The multi-pulse laser light which consists of a head heating pulse, a consecutive continuation heating pulse, and a continuous cooling pulse located among these pulses and by which intensity modulation was carried out is irradiated. In the record approach for phase change type light DIKUSUKU which recorded information by forming the record mark whose die length bears information The record mark length who becomes a write-in object, the tooth-space length in front of this record mark, And the record approach for phase-change optical disks characterized by changing the front edge timing of the head cooling pulse just behind that head heating pulse based on the preceding-record mark length of this tooth space, and amending a head cooldown delay.
[Claim 11] As opposed to the phase-change optical disk which has the recording layer which carries out a phase change reversibly with a crystal phase and an amorphous phase The multi-pulse laser light which consists of a head heating pulse, a consecutive continuation heating pulse, and a continuous cooling pulse located among these pulses and by which intensity modulation was carried out is irradiated. In the record approach for phase change type light DIKUSUKU which recorded information by forming the record mark whose die length bears information While changing the front edge timing of the head cooling pulse just behind that head heating pulse based on the record mark length who becomes a write-in object, the tooth-space length in front of this record mark, and the preceding-record mark length of this tooth space The record approach for phase-change optical disks characterized by changing the back edge timing of the aftercooling pulse just behind the last heating pulse based on the record mark length who becomes a write-in object, and the tooth-space length immediately after this record mark, and amending a head cooldown delay and aftercooling time amount.
[Claim 12] The record approach for phase-change optical disks according to claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, or 11 characterized by setting the smallest unit of the amount of amendments to which is equipped with the integral multiple clock of an integral multiple to the same reference clock as the record signal frequency which generates the continuation heating pulse and continuous cooling pulse for record, and this reference clock, and edge timing is changed as pulse width with this integral multiple clock.
[Claim 13] The record approach for phase-change optical disks according to claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, or 12 characterized by being aimed at the phase-change optical disk which a recording layer becomes from the record ingredient of an AgInSbTe system.

[Translation done.]

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the record approach for phase-change optical disks.
[0002]
[Description of the Prior Art] The media only for playbacks and information regenerative apparatus, such as CD for music (compact TISUKU) and CD-ROM, are put in practical use with the spread of multimedia. Recently, the phase-change optical disk also attracts attention besides the rewritable MO disk using the write once optical disk and magneto-optical media which used coloring matter media. This phase-change optical disk carries out the phase change of the record ingredient reversibly with a crystal phase and an amorphous phase, and records information. Under the present circumstances, the exaggerated light record which unlike MO media etc. cannot need an external magnetic field, can perform record and playback only by the laser beam, and can perform informational record and informational elimination at once by the exposure of a laser beam also has the description of being possible.
[0003] By the way, there is a single pulse recording method recorded by forming a record mark by making a laser light source drive by the single pulse luminescence wave as shown in drawing 16 as a general record wave in a phase-change optical disk. However, by such recording method, distortion of the shape of a tear as shown in a record mark in drawing 16 for the heat which carried out accumulation is produced, or a cooling rate is insufficient, it becomes inadequate forming [of an amorphous phase (a record mark is formed of an amorphous phase)], and there is a problem that the low reflection by the amorphous phase is not obtained. This is because record is performed by the heat mode in which the condition of a recording layer is determined depending on attainment temperature and a cooling rate, so it has the property which a thermal nonlinear distortion tends to generate in a record process.
[0004] He is trying to record in fact, from such a thing, by forming a record mark by the multi-pulse recording method which used multistage record power, as shown in drawing 17 . Such a recording method is announced for example, in "examination of high-speed record rate and the high density recording method for phase change disks" (reference 1) of a television society technical report (December 16, 1993) (ITE Technical Report Vol.17.No.79.PP.7-12 VIR'93-83).
[0005] The multi-pulse luminescence wave is constituted so that a record mark may be formed here by the continuous cooling pulse C located between the head heating pulse A, the consecutive continuation heating pulses B, and these pulses, if it is in a multi-pulse recording method. Moreover, the record luminescence power of each pulse is set as PWB>=PWA>PWC**PR (= playback power). That is, multi-pulse shape is made into the wave by which intensity modulation was carried out. Moreover, the IRESU pulse D is prepared for the tooth-space sections located between record marks, and the elimination luminescence power PED is set as PWA<PED<PWC. By making a laser light source control and drive based on such a multi-pulse luminescence wave, reflection factor difference sufficient between a record mark and a tooth space can be given.
[0006] On the other hand, although there are a mark position recording method (PPM= pulse-position-

modulation method) and a mark edge recording method (PWM= pulse width modulation) which forms a record mark with the gestalt in which die length bears information as an informational recording method, recently, it is in the inclination for the mark edge recording method which can respond to much more densification to be used. Since the front edge and back edge of a record mark correspond to a symbolic-language bit respectively in the case of this mark edge recording method, accuracy is required of an edge location. However, since the heating + cooling conditions other than distortion of the shape of a tear which was mentioned above differ actually according to record mark length when it records on a phase-change optical disk by the mark edge recording method, producing an edge shift on the front edge or back edge of a record mark is known.

[0007] According to JP,6-64741,B, as a cure in such an edge shift, there are some which the width of face of a record pulse is changed and amended it by changing the front edge timing of a record pulse according to spacing with the last pulse, i.e., the tooth-space length in front of a record mark. Moreover, in case it records on a phase-change optical disk, in order to amend the edge shift generated by specific record patterns, such as 2T mark / tooth space which is easy to produce an edge shift, according to the reference 1 mentioned above, when a specific record pattern is detected, there are some which tuned the front edge timing and back edge timing of a record pulse finely by switching the set point of a delay line on real time. If these amendment methods are summarized and it thinks by the multi-pulse recording method, as shown in drawing 18 , they are the front edge timing of the head heating pulse A, or the last heating pulse BL. It can be called the technique of amending back edge timing.

[0008]

[Problem(s) to be Solved by the Invention] However, in a phase-change optical disk, since it is formed by quenching (heating -> cooling) and is not satisfied with amendment of heating pulse width as shown in drawing 18 of quenching conditions, a record mark = amorphous phase not much often has amendment precision in the present condition that the jitter of spacing during a record mark is large. As shown in drawing 19 , in the relation between the amount of amendments of a heating pulse (the amount of order edge amendments), and the edge shift variation of the record mark formed, to the amount of amendments, since there is very little edge shift variation, a setup of the amount of amendments is difficult for this, and it is considered because it cannot amend proper.

[0009] Moreover, since it generates according to other factors, the amendment method of heating pulse width of the edge shift of a record mark is inadequate. The factor of this edge shift is the edge shift by thermal interference with the contiguity record mark depending on the tooth-space length before and after a record mark. That is, this thermal interference is for being influenced by the record mark of the front edge and back edge of a record mark used as a write-in object of in front of that record mark and an immediately after of heating. An edge shift is produced in the direction in which extent of thermal interference changes with tooth-space length of in front of the record mark used as a write-in object, and an immediately after, effect becomes large, so that effect is so small that the tooth-space length is long and tooth-space length is short, and a record mark becomes long. By the amendment method of heating pulse width which was mentioned above, since there is too little edge shift variation to the amount of amendments, the case of such an edge shift of a factor is also difficult, and a setup of the amount of amendments cannot amend it proper.

[0010] Furthermore, although the mark edge recording method is suitable for densification, if densification progresses, the edge shift by the accumulation of the preceding-record mark depending on the preceding-record mark length other than the edge shift by heat interference also exists. Since the heating values by which accumulation was carried out according to preceding-record mark length differ, this is for the front edge of a record mark which should be recorded to produce an edge shift in response to the effect of the heating value. An edge shift is produced in the direction in which extent of accumulation changes with preceding-record mark length, effect becomes large, so that effect is so small that the record mark length is short and it is long, and a record mark becomes long. What is necessary is just to amend a record pulse = heating pulse according to the combination of the record mark length who should record, tooth-space length, and preceding-record mark length in front of that, in order to amend such an edge shift component. However, by such amendment method of heating pulse width, since there

is too little edge shift variation to the amount of amendments, a setup of the amount of amendments is difficult and cannot amend proper.
[0011] Then, this invention amends the edge shift of the record mark which may be produced according to various factors proper, and sets it as the offering-record approach for phase-change optical disks which can control jitter of record mark spacing purpose.
[0012]
[Means for Solving the Problem] The record approach for phase-change optical disks of invention according to claim 1 As opposed to the phase-change optical disk which has the recording layer which carries out a phase change reversibly with a crystal phase and an amorphous phase The multi-pulse laser light which consists of a head heating pulse, a consecutive continuation heating pulse, and a continuous cooling pulse located among these pulses and by which intensity modulation was carried out is irradiated. In the record approach for phase change type light DIKUSUKU which recorded information by forming the record mark whose die length bears information Based on the record mark length who becomes a write-in object, the front edge timing of the head cooling pulse just behind the head heating pulse is changed, and the head cooldown delay was amended.
[0013] In the same record approach for phase-change optical disks as invention according to claim 1, the record approach for phase-change optical disks of invention according to claim 2 changes the back edge timing of the aftercooling pulse just behind the last heating pulse based on the record mark length who becomes a write-in object, and amended aftercooling time amount.
[0014] In the same record approach for phase-change optical disks as invention according to claim 1, the record approach for phase-change optical disks of invention according to claim 3 changes the back edge timing of the aftercooling pulse just behind the last heating pulse, and amended a head cooldown delay and aftercooling time amount while it changed the front edge timing of the head cooling pulse just behind the head heating pulse based on the record mark length who becomes a write-in object.
[0015] In the same record approach for phase-change optical disks as invention according to claim 1, the record approach for phase-change optical disks of invention according to claim 4 changes the front edge timing of the head cooling pulse just behind a head heating pulse based on the tooth-space length in front of the record mark used as a write-in object, and amended the head cooldown delay.
[0016] In the same record approach for phase-change optical disks as invention according to claim 1, the record approach for phase-change optical disks of invention according to claim 5 changes the back edge timing of the aftercooling pulse just behind the last heating pulse based on the tooth-space length immediately after the record mark used as a write-in object, and amended aftercooling time amount.
[0017] The record approach for phase-change optical disks of invention according to claim 6 While changing the front edge timing of the head cooling pulse just behind a head heating pulse based on the tooth-space length in front of the record mark used as a write-in object in the same record approach for phase-change optical disks as invention according to claim 1 Based on the tooth-space length immediately after the record mark used as a write-in object, the back edge timing of the aftercooling pulse just behind the last heating pulse is changed, and a head cooldown delay and aftercooling time amount were amended.
[0018] In the same record approach for phase-change optical disks as invention according to claim 1, the record approach for phase-change optical disks of invention according to claim 7 changes the front edge timing of the head cooling pulse just behind a head heating pulse based on the record mark length who becomes a write-in object, and the tooth-space length in front of this record mark, and amended the head cooldown delay.
[0019] In the same record approach for phase-change optical disks as invention according to claim 1, the record approach for phase-change optical disks of invention according to claim 8 changes the back edge timing of the aftercooling pulse just behind the last heating pulse based on the record mark length who becomes a write-in object, and the tooth-space length immediately after this record mark, and amended aftercooling time amount.
[0020] The record approach for phase-change optical disks of invention according to claim 9 In the same record approach for phase-change optical disks as invention according to claim 1 While changing the

front edge timing of the head cooling pulse just behind a head heating pulse based on the record mark length who becomes a write-in object, and the tooth-space length in front of this record mark Based on the record mark length who becomes a write-in object, and the tooth-space length immediately after this record mark, the back edge timing of the aftercooling pulse just behind the last heating pulse is changed, and a head cooldown delay and aftercooling time amount were amended.
[0021] In the same record approach for phase-change optical disks as invention according to claim 1, the record approach for phase-change optical disks of invention according to claim 10 changes the front edge timing of the head cooling pulse just behind that head heating pulse based on the record mark length who becomes a write-in object, the tooth-space length in front of this record mark, and the preceding-record mark length of this tooth space, and amended the head cooldown delay.
[0022] The record approach for phase-change optical disks of invention according to claim 11 In the same record approach for phase-change optical disks as invention according to claim 1 While changing the front edge timing of the head cooling pulse just behind that head heating pulse based on the record mark length who becomes a write-in object, the tooth-space length in front of this record mark, and the preceding-record mark length of this tooth space Based on the record mark length who becomes a write-in object, and the tooth-space length immediately after this record mark, the back edge timing of the aftercooling pulse just behind the last heating pulse is changed, and a head cooldown delay and aftercooling time amount were amended.
[0023] Invention according to claim 12 was the record approach for phase-change optical disks according to claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, or 11, was equipped with the integral multiple clock of an integral multiple to the same reference clock as the record signal frequency which generates the continuation heating pulse and continuous cooling pulse for record, and this reference clock, and set the smallest unit of the amount of amendments to which edge timing is changed as pulse width with this integral multiple clock.
[0024] Invention according to claim 13 is the record approach for phase-change optical disks according to claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, or 12, and was aimed at the phase-change optical disk which a recording layer becomes from the record ingredient of an AgInSbTe system.
[0025]
[Function] In invention according to claim 1, since the front edge timing of the head cooling pulse just behind the head heating pulse is changed based on the record mark length who becomes a write-in object and a head cooldown delay is amended, by fulfilling quenching conditions, it can amend proper so that the front edge shift of a record mark may decrease, and the jitter of record mark spacing decreases.
[0026] In invention according to claim 2, since the back edge timing of the aftercooling pulse just behind the last heating pulse is changed based on the record mark length who becomes a write-in object and aftercooling time amount is amended, by fulfilling quenching conditions, it can amend proper so that an edge shift may decrease after a record mark, and the jitter of record mark spacing decreases.
[0027] While changing the front edge timing of the head cooling pulse just behind the head heating pulse in invention according to claim 3 based on the record mark length who becomes a write-in object Since the back edge timing of the aftercooling pulse just behind the last heating pulse is changed and a head cooldown delay and aftercooling time amount are amended The jitter of record mark spacing decreases without being able to amend proper so that the front edge shift of a record mark and a back edge shift may decrease by fulfilling quenching conditions, and the jitter of tooth-space spacing getting worse.
[0028] Since the front edge timing of the head cooling pulse just behind a head heating pulse is changed in invention according to claim 4 based on the tooth-space length in front of the record mark used as a write-in object and a head cooldown delay is amended The cooling conditions over the front edge shift of the record mark by thermal interference of the record marks depending on the previous tooth-space length will be fulfilled, it can amend proper so that the front edge shift of a record mark may decrease, and the jitter of record mark spacing decreases.
[0029] Since the back edge timing of the aftercooling pulse just behind the last heating pulse is changed

in invention according to claim 5 based on the tooth-space length immediately after the record mark used as a write-in object and aftercooling time amount is amended The cooling conditions over an edge shift will be fulfilled after the record mark by thermal interference of the record marks depending on the next tooth-space length, it can amend proper so that an edge shift may decrease after a record mark, and the jitter of record mark spacing decreases.

[0030] While changing the front edge timing of the head cooling pulse just behind a head heating pulse in invention according to claim 6 based on the tooth-space length in front of the record mark used as a write-in object Since the back edge timing of the aftercooling pulse just behind the last heating pulse is changed based on the tooth-space length immediately after the record mark used as a write-in object and a head cooldown delay and aftercooling time amount are amended The cooling conditions over the front edge shift of a record mark and back edge shift by thermal interference of the record marks depending on the tooth-space length of just before and an immediately after will be fulfilled. The jitter of record mark spacing decreases without being able to amend proper so that the front edge shift of a record mark and a back edge shift may decrease, and the jitter of tooth-space spacing getting worse.

[0031] Since the front edge timing of the head cooling pulse just behind a head heating pulse is changed in invention according to claim 7 based on the record mark length who becomes a write-in object, and the tooth-space length in front of this record mark and a head cooldown delay is amended The cooling conditions over the front edge shift of the record mark by thermal interference of the record marks depending on record mark length and the previous tooth-space length will be fulfilled, it can amend proper so that the front edge shift of a record mark may decrease, and the jitter of record mark spacing decreases.

[0032] Since the back edge timing of the aftercooling pulse just behind the last heating pulse is changed in invention according to claim 8 based on the record mark length who becomes a write-in object, and the tooth-space length immediately after this record mark and aftercooling time amount is amended The cooling conditions over an edge shift will be fulfilled after the record mark by thermal interference of the record marks depending on record mark length and the next tooth-space length, it can amend proper so that an edge shift may decrease after a record mark, and the jitter of record mark spacing decreases.

[0033] While changing the front edge timing of the head cooling pulse just behind a head heating pulse in invention according to claim 9 based on the record mark length who becomes a write-in object, and the tooth-space length in front of this record mark Since the back edge timing of the aftercooling pulse just behind the last heating pulse is changed based on the record mark length who becomes a write-in object, and the tooth-space length immediately after this record mark and a head cooldown delay and aftercooling time amount are amended The cooling conditions over the front edge shift of a record mark and back edge shift by thermal interference of the record marks which were dependent on the tooth-space length of just before and an immediately after at the record mark length list will be fulfilled. The jitter of record mark spacing decreases without being able to amend proper so that the front edge shift of a record mark and a back edge shift may decrease, and the jitter of tooth-space spacing getting worse.

[0034] The record mark length who becomes a write-in object in invention according to claim 10, the tooth-space length in front of this record mark, And since the front edge timing of the head cooling pulse just behind that head heating pulse is changed based on the preceding-record mark length of this tooth space and a head cooldown delay is amended The front edge shift of the record mark by the accumulation depending on preceding-record mark length, The cooling conditions over the front edge shift of the record mark depending on the previous tooth-space length and the front edge shift by the heat interference depending on record mark length will be fulfilled, it can amend with high precision so that the front edge shift of a record mark may decrease, and the jitter of record mark spacing decreases.

[0035] The record mark length who becomes a write-in object in invention according to claim 11, the tooth-space length in front of this record mark, And while changing the front edge timing of the head cooling pulse just behind that head heating pulse based on the preceding-record mark length of this tooth space Since the back edge timing of the aftercooling pulse just behind the last heating pulse is changed based on the record mark length who becomes a write-in object, and the tooth-space length immediately after this record mark and a head cooldown delay and aftercooling time amount are amended The jitter

of record mark spacing decreases without fulfilling the cooling conditions over the edge shift of the record mark by almost all factors, being able to amend with high precision so that the front edge shift of a record mark and a back edge shift may decrease, and the jitter of tooth-space spacing getting worse.
[0036] In invention according to claim 12, since the smallest unit of the amount of amendments to which is equipped with the integral multiple clock of an integral multiple to the same reference clock as the record signal frequency which generates the continuation heating pulse and continuous cooling pulse for record, and this reference clock, and edge timing is changed is set as pulse width with this integral multiple clock, it can realize by the logical circuit altogether including amendment of edge timing, and ends with low cost in a small-scale amendment circuit.
[0037] In invention according to claim 13, since it is aimed at the phase-change optical disk which a recording layer becomes from the record ingredient of an AgInSbTe system, exact amendment which suited the property of a recording layer to the edge shift by heat interference or accumulation operation can be performed.
[0038]
[Example] Claim 1 and one example of invention given in 13 are explained based on drawing 1 R> 1 and drawing 2 . It applies to the recording method which records the code data of a CD-ROM format using a phase-change optical disk (exaggerated light), and this example is EFM (Eight Fourteen Modulation) as a data modulation technique, for example. It shall record by the mark ESSHI recording method using a modulation code. Therefore, if in charge of actual record, information will be recorded by making light emit according to a multi-pulse luminescence wave which explained the laser diode by drawing 17 using such record data, and forming a record mark = amorphous phase.
[0039] First, drawing 1 (b) shows the multi-pulse luminescence wave before the amendment in the case of carrying out which will form the record mark of the record mark length M1. Then, based on the result of having measured the shift amount of the front edge of a record mark in case there is no amendment, according to the record mark length M1 of a record mark who becomes the write-in object which should be recorded, as shown in drawing 1 (c), it is the head cooling pulse CF just behind the head heating pulse A. Front edge timing is changed. This amends a head cooldown delay. Only the same time amount (timing) as the edge shift amount is the head cooling pulse CF so that the front edge shift of the record mark used as a write-in object may be negated in this example. It has amended so that front edge timing may become late or early.
[0040] thus, head cooling pulse CF by amending front edge timing, average edge spacing of the target record mark is the same as the amount of amendments -- since it ******, the cooling conditions for quenching will be fulfilled and a changed part of the record mark length by edge shift can be canceled. Therefore, the front edge shift of a record mark can be reduced and the jitter of record mark spacing can be stopped small.
[0041] Especially the record approach of this example is effective when the front edge shift of a record mark is aimed at the record lamination and the record wave which are generated notably. This point is explained with reference to drawing 2 . Generally, as a record ingredient of the recording layer of a phase-change optical disk, there are a GeSbTe system, a GeTeSbS system, a TeGeSnAu system, a GeTeSn system, a SbSe system, a SbSeTe system, a SnSeTe system, a GaSeTe system, a GaSeTeGe system, an InSe system, an InSe system, an InSeTe system, an AgInSbTe system, etc. When recording data on the phase-change optical disk equipped with the recording layer by such record ingredient, it is the head cooling pulse CF. When it records by changing front edge timing and changing the pulse width (= head cooldown delay) from a certified value, as shown in drawing 2 R> 2, it is in the inclination for the edge shift variation of a record pulse to appear as almost linear relation to the variation (variation of = time amount) of pulse width. When the record ingredient of an AgInSbTe system is used especially, it appears notably. Such an inclination is the aftercooling pulse CL like the example mentioned later. It is also the same as when changing back edge timing, changing the pulse width (= aftercooling time amount) from a certified value and recording. For this, such a recording layer is the head cooling pulse CF. Front edge timing and aftercooling pulse CL It is thought that it is because the edge of the record mark formed corresponds correctly to back edge timing. Therefore, like the example mentioned later,

since it can amend correctly to the edge shift by heat interference or accumulation operation, it becomes effective.
[0042] In addition, what is necessary is just to, set up the record mark length M1 and the amount of amendments which should be amended in short so that the tolerable jitter of a regenerative signal may be satisfied since it changes with a modulation code, recording density, etc. Therefore, what is necessary is to set up small the amount of the minimum amendments to all record mark length or two or more record mark length, and just to amend it with high precision, when the margin of a tolerable jitter is severe. Moreover, amended head cooling pulse CF What is necessary is to prepare delay circuits, such as a delay line of a multiple tap, and two or more mono-multivibrators, and just to constitute as a means generated with a sufficient precision multistage, so that it may switch to real time according to record mark length (it is the same also in each following example).
[0043] Moreover, although the example which records the code data based on the eight-to-fourteen modulation of a CD-ROM format explained in this example, when recording according to other formats or other modulation codes, it can apply similarly (in each following example, it is applicable similarly). Furthermore, although the pulse width of the head heating pulse A is set constant in this example, front edge timing of this head heating pulse A is considered as immobilization, and it is the head cooling pulse CF. According to amendment (modification of front edge timing), you may constitute so that the width of face of the head heating pulse A may change (about this point, it is applicable similarly in each following example).
[0044] It continues and drawing 3 explains one example of invention according to claim 2. in addition, the recording method which that of a fundamental recording method and a record wave is the same as that of the case of said example, and records the code data of a CD-ROM format also in each example of the following containing this example using a phase-change optical disk -- eight-to-fourteen modulation -- a code -- it considers as the example recorded by the mark ESSHI recording method using a data modulation technique.
[0045] Based on the result of having measured the edge shift amount of a record mark in case there is no amendment in this example, according to the record mark length M1 of a record mark who becomes a write-in object, as shown in drawing 3 (c), it is the last heating pulse BL. The next aftercooling pulse CL Back edge timing is changed. This amends aftercooling time amount. In this example, only the same time amount (timing) as the edge shift amount is amended so that the back edge timing of the aftercooling pulse CL may become late or early, so that an edge shift may be negated after the record mark used as a write-in object.
[0046] thus, aftercooling pulse CL by amending back edge timing, average edge spacing of the target record mark is the same as the amount of amendments -- since it ******, the cooling conditions for quenching will be fulfilled and a changed part of the record mark length by edge shift can be canceled. Therefore, an edge shift can be reduced after a record mark and the jitter of record mark spacing can be stopped small. Especially the record approach of this example is effective when an edge shift is aimed at the record lamination (thing using the record ingredient of an AgInSbTe system especially) and the record wave which are generated notably after a record mark.
[0047] Drawing 4 and drawing 5 explain one example of invention according to claim 3. This example combines two examples mentioned above. Based on the result of having measured the edge shift amount of a record mark in case there is no amendment, according to the record mark length M1 of a record mark who becomes a write-in object, as shown in drawing 4 (c), it is the head cooling pulse CF just behind the head heating pulse A. While changing front edge timing, it is the last heating pulse BL. The next aftercooling pulse CL Back edge timing is changed. This amends a head cooldown delay and aftercooling time amount. Only the same time amount (timing) as each edge shift amount is the head cooling pulse CF so that the edge shift before and after the record mark used as a write-in object may be negated in this example. Front edge timing and aftercooling pulse CL It has amended so that back edge timing may become late or early.
[0048] thus, head cooling pulse CF by amending front edge timing and the back edge timing of the aftercooling pulse CL, average edge spacing of the target record mark is the same as the amount of

amendments -- since it ******, the cooling conditions for quenching will be fulfilled and a changed part of the record mark length by edge shift can be canceled. Therefore, the edge shift before and after a record mark can be reduced, and the jitter of record mark spacing can be stopped small. Especially the record approach of this example is effective when the edge shift before and after a record mark is aimed at the record lamination (thing using the record ingredient of an AgInSbTe system especially) and the record wave which are generated notably. Furthermore, the edge shift toward which tooth-space length before and after originating in amending record mark length only with the edge of next one side inclined can also prevent a front stirrup. Therefore, the jitter of record mark spacing can be stopped small, without worsening the jitter of tooth-space spacing.
[0049] By the way, drawing 5 explains the example of circuitry for realizing the record approach of this example. The data correction detecting element 1 and the multi-pulse generating section 2 which consider the data based on an eight-to-fourteen modulation code as an input are prepared. Based on the output of these data correction detecting elements 1 and the multi-pulse generating section 2 The data correction section 3 which performs amendment processing is formed, and the output timing generator 4 which outputs each pulses A, B, and C based on the output of this data correction section 3 is controlled, and it is constituted so that LD power control signal over a laser diode (not shown) may be generated.
[0050] The mark / tooth-space detector 5 with which the data correction detecting element 1 distinguishes a record mark and a tooth space in EFM data here, The mark / tooth-space selector 6 which outputs the selection signal according to the detection result of this mark / tooth-space detector 5,

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the timing diagram which shows claim 1 and one example of invention given in 13.
[Drawing 2] It is the property Fig. showing the relation between the amount of order edge amendments, and an edge shift amount.
[Drawing 3] It is the timing diagram which shows one example of invention according to claim 2.
[Drawing 4] It is the timing diagram which shows one example of invention according to claim 3.
[Drawing 5] It is the block diagram showing amendment circuitry.
[Drawing 6] It is the timing diagram which shows one example of invention according to claim 4.
[Drawing 7] It is the timing diagram which shows one example of invention according to claim 5.
[Drawing 8] It is the timing diagram which shows one example of invention according to claim 6.
[Drawing 9] It is the timing diagram which shows one example of invention according to claim 7.
[Drawing 10] It is the timing diagram which shows one example of invention according to claim 8.
[Drawing 11] It is the timing diagram which shows one example of invention according to claim 9.
[Drawing 12] It is the timing diagram which shows one example of invention according to claim 10.
[Drawing 13] It is the timing diagram which shows one example of invention according to claim 11.
[Drawing 14] It is the timing diagram which shows one example of invention according to claim 12.
[Drawing 15] It is the block diagram showing LD drive circuit.
[Drawing 16] It is the timing diagram which shows the example of record mark formation by the single pulse luminescence wave.
[Drawing 17] It is the timing diagram which shows the example of record mark formation by the multi-pulse luminescence wave.
[Drawing 18] It is the timing diagram which shows the example of amendment of the heating pulse.
[Drawing 19] It is the property Fig. showing the relation between the amount of order edge amendments, and an edge shift amount.
[Description of Notations]
A Head heating pulse
B Continuation heating pulse
BL The last heating pulse
C Continuous cooling pulse
CF Head cooling pulse
CL Aftercooling pulse
M1 Record mark length
M2 Preceding-record mark length
S1 The previous tooth-space length
S2 The next tooth-space length

[Translation done.]

* NOTICES *

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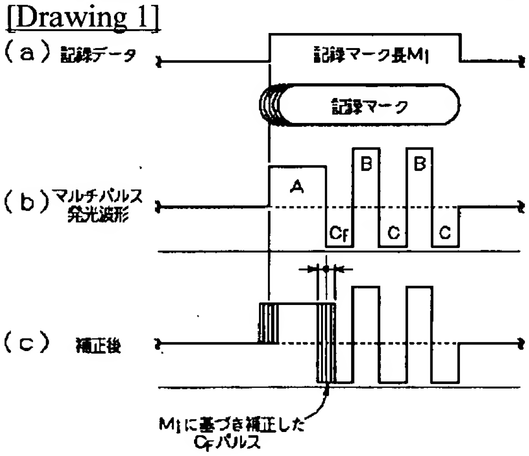
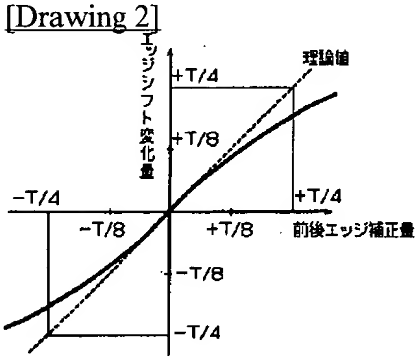
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

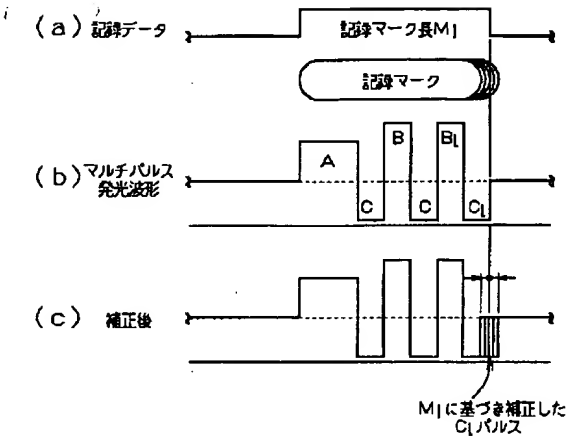
[Drawing 1]



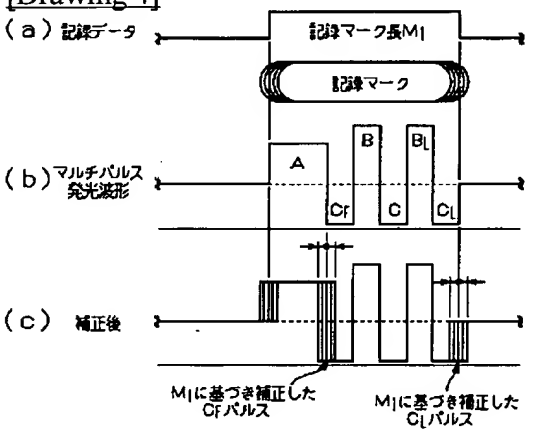
[Drawing 2]



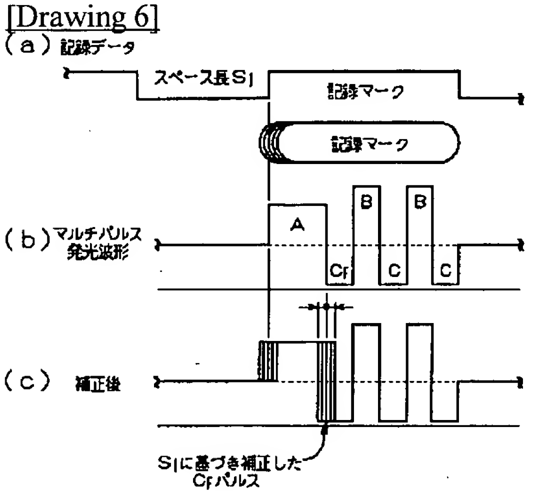
[Drawing 3]



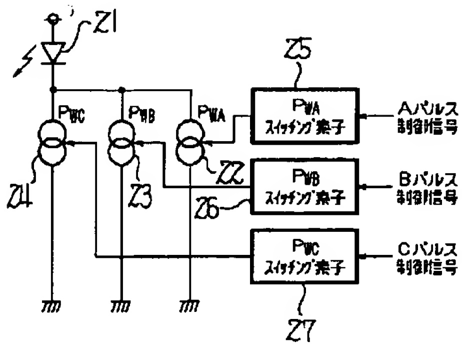
[Drawing 4]



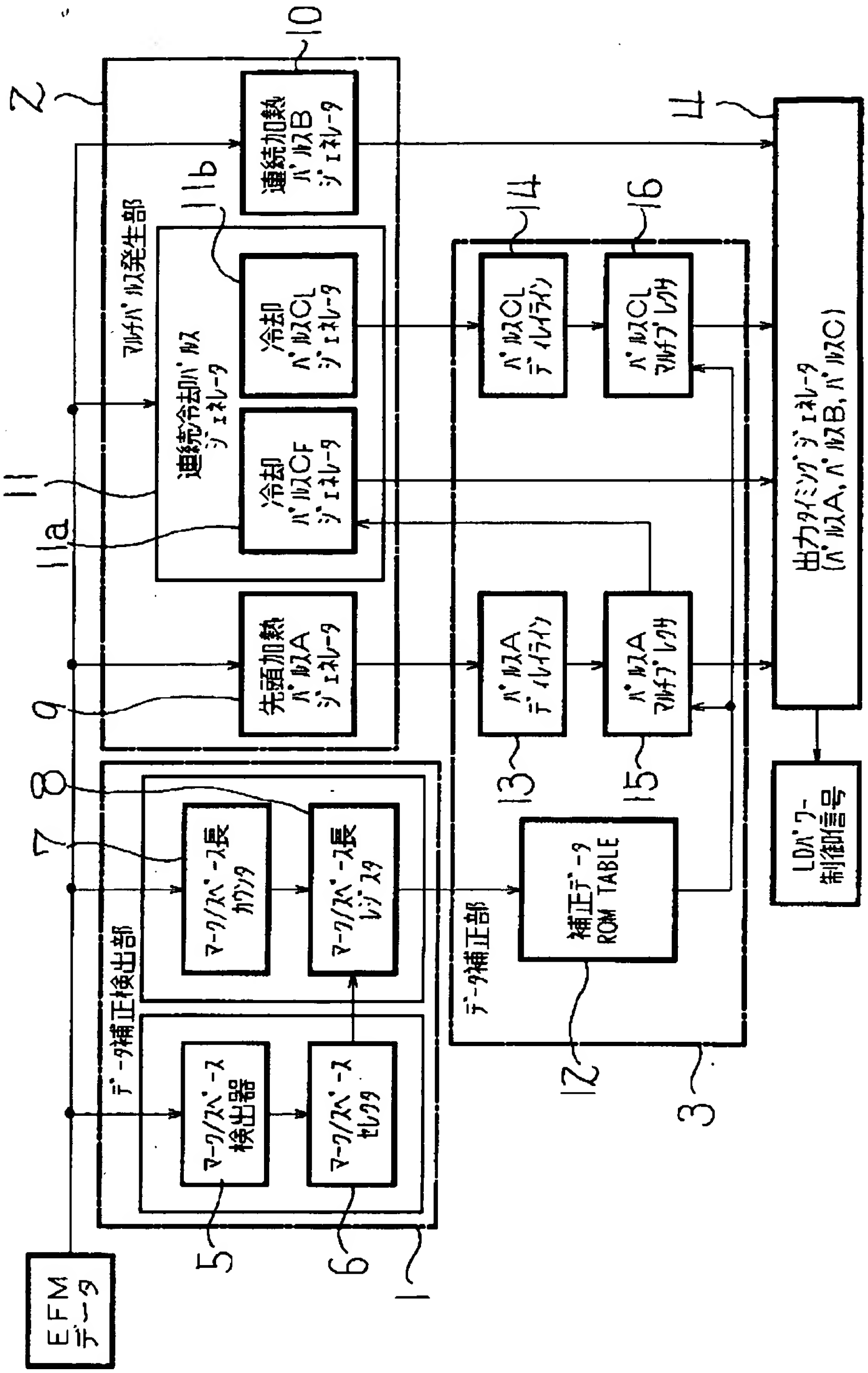
[Drawing 6]



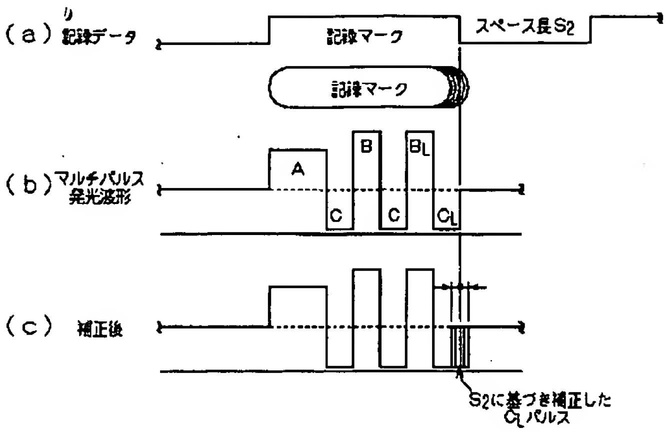
[Drawing 15]


Z1
Z5
PWC
PWB
PWA
PWA スイッチング素子
Aパルス制御信号
Z2
Z4
Z3
Z6
PWB スイッチング素子
Bパルス制御信号
PWC スイッチング素子
Cパルス制御信号
Z7

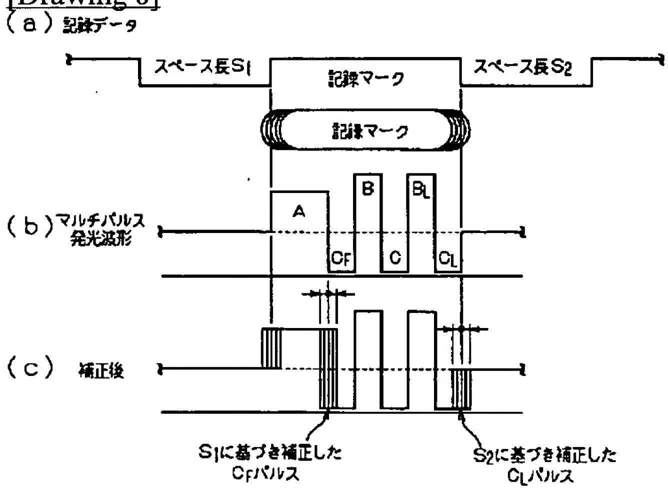
[Drawing 5]


EFMデータ
データ補正検出部
マーク/スペース検出器
マーク/スペースセレクタ
マーク/スペース長カウンタ
マーク/スペース長レジスタ
マルチパルス発生部
先頭加熱パルスAジェネレータ
連続冷却パルスジェネレータ
冷却パルスCFジェネレータ
冷却パルスCLジェネレータ
連続加熱パルスBジェネレータ
データ補正部
補正データROM TABLE
パルスAディレイライン
パルスAマルチプレクサ
パルスCLディレイライン
パルスCLマルチプレクサ
出力タイミングジェネレータ (パルスA, パルスB, パルスC)
LDパワー制御信号
1
2
3
5
6
7
8
9
10
11
11a
11b
12
13
14
15
16
17

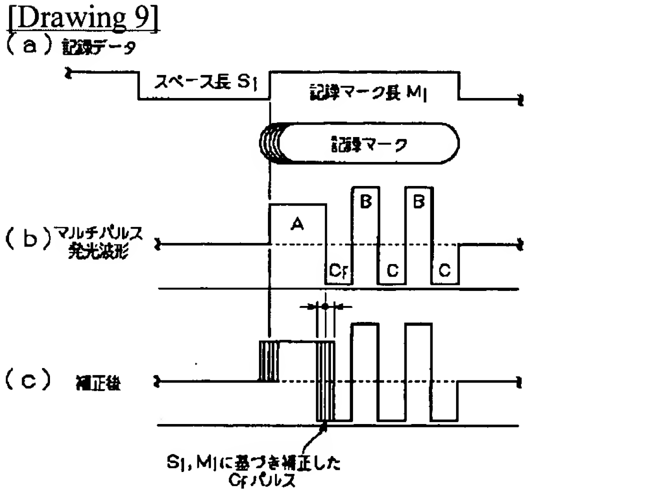
[Drawing 7]



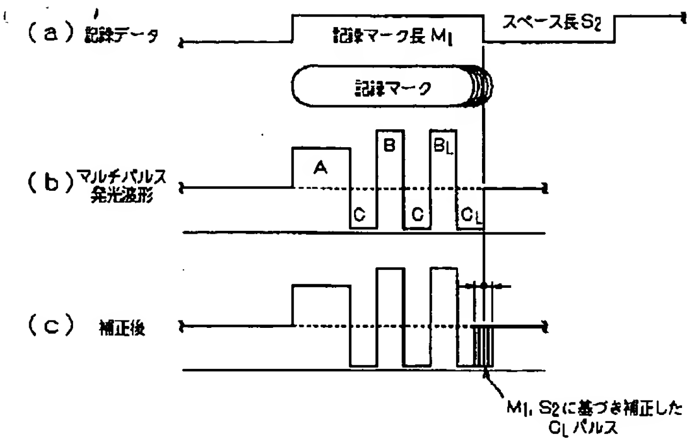
[Drawing 8]



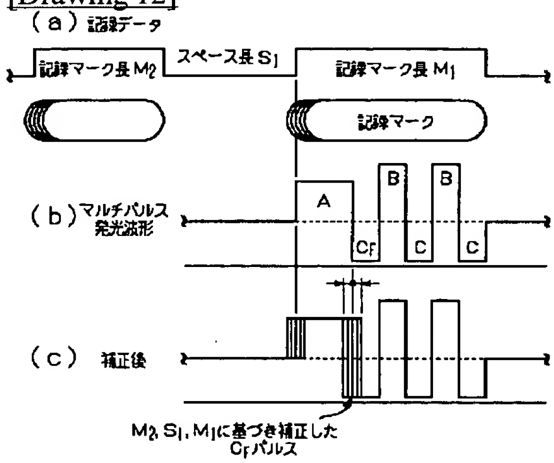
[Drawing 9]



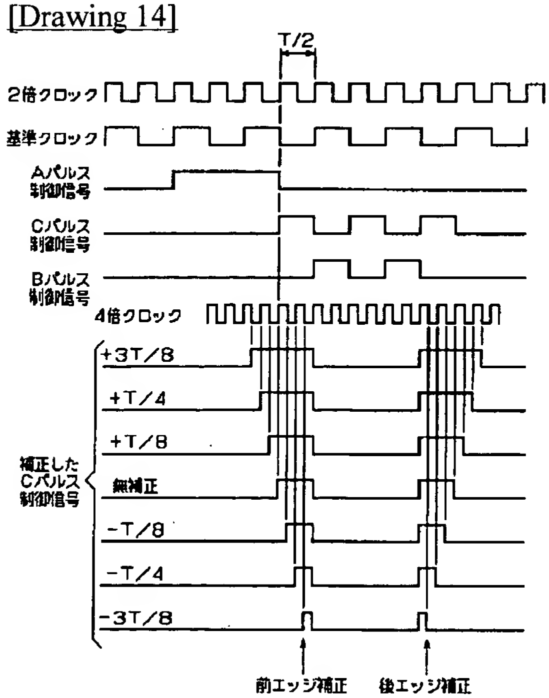
[Drawing 10]



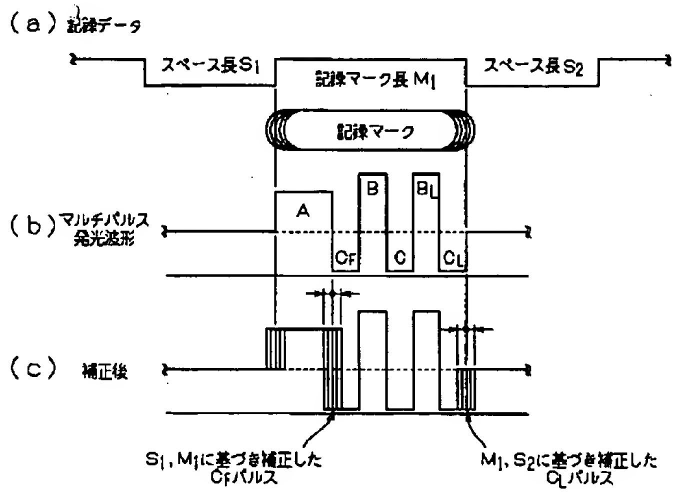
[Drawing 12]



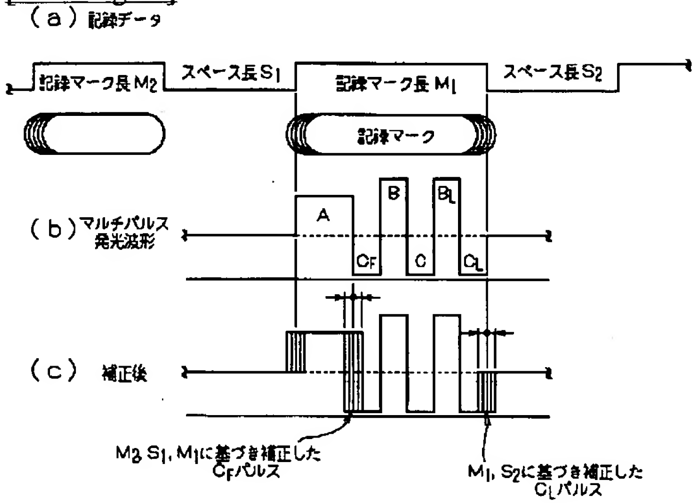
[Drawing 14]



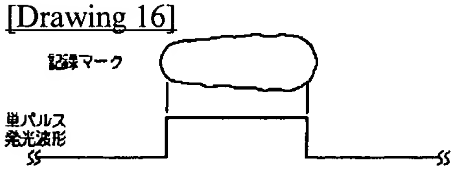
[Drawing 11]



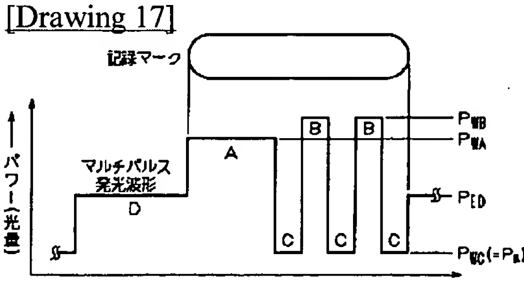
[Drawing 13]



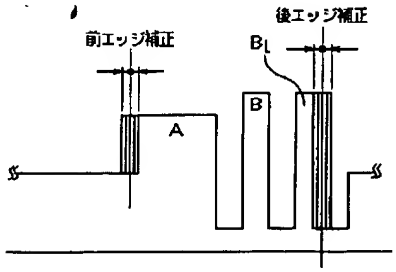
[Drawing 16]



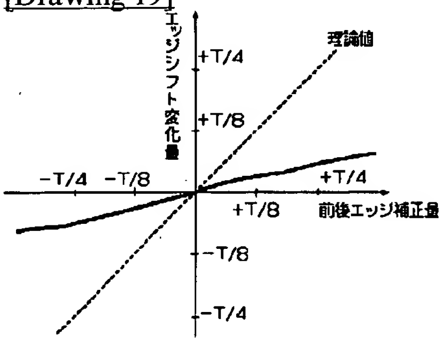
[Drawing 17]



[Drawing 18]



[Drawing 19]



[Translation done.]

CORRECTION OR AMENDMENT

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[Section partition] The 4th partition of the 6th section
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7/125

[FI]

G11B 7/00 F
L
7/125 C

[Procedure revision]
[Filing Date] January 29, Heisei 11
[Procedure amendment 1]
[Document to be Amended] Specification
[Item(s) to be Amended] Claim
[Method of Amendment] Modification
[Proposed Amendment]
[Claim(s)]
[Claim 1] As opposed to the phase-change optical disk which has the recording layer which carries out a phase change reversibly with a crystal phase and an amorphous phase The multi-pulse laser light which consists of a head heating pulse, a consecutive continuation heating pulse, and a continuous cooling pulse located among these pulses and by which intensity modulation was carried out is irradiated. In the record approach for phase-change optical disks which recorded information by forming the record mark whose die length bears information The record approach for phase-change optical disks characterized by changing the front edge timing of the head cooling pulse just behind the head heating pulse based on the record mark length who becomes a write-in object, and amending a head cooldown delay.
[Claim 2] As opposed to the phase-change optical disk which has the recording layer which carries out a phase change reversibly with a crystal phase and an amorphous phase The multi-pulse laser light which consists of a head heating pulse, a consecutive continuation heating pulse, and a continuous cooling

pulse located among these pulses and by which intensity modulation was carried out is irradiated. In the record approach for phase-change optical disks which recorded information by forming the record mark whose die length bears information The record approach for phase-change optical disks characterized by changing the back edge timing of the aftercooling pulse just behind the last heating pulse based on the record mark length who becomes a write-in object, and amending aftercooling time amount.